Space Weather Technical Forecast

Issued on Wednesday, 20 April 2022 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares likely throughout (R1/R2 radio blackouts). Slight chance of X-flares (R3 radio blackouts). Increasing but slight chance of S1/Minor radiation storms. Active Electron Fluence likely.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate over the past 24 hours, with an M1 flare from AR2993 in the northeast and an M3 flare from ex-2992 over the southwest limb. There are currently five sunspot regions on the visible disc. Of these, AR2993 and AR2994 close together in the northeast are by far the largest and most complex, and these represent the majority of the current flare risk alongside the declining risk from ex-2992 as it rotates away. The other regions currently appear simple and stable, although AR2995 is still a little close to the northeast limb to be certain of the analysis. No Earth directed CMEs were seen in available imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, showed declining fast wind characteristics, likely from CH75/+. The solar wind speed has declined slightly from around 510-570 km/s to vary between 440-470 km/s. The density was average or below average. The Interplanetary Magnetic Field, Bt, was weak throughout below 6nT. The north-south component, Bz, varied weakly between +/-4 nT. The phi angle was largely positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at Background levels throughout. The high energy electron electron flux (greater than 2MeV) reached High levels at the diurnal maximum, with 2220 pfu recorded at 19/1715 UTC. The corresponding 24-hour integrated electron fluence has been on a rising trend and is now close to the Active threshold, reaching 9.23e7 integrated pfu at 20/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is likely to be Moderate over the next four days, with a Slight Chance of X-class flares, mainly from the large and fairly complex regions currently in the northeast quadrant.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the forecast. Earth is likely to continue exiting from the current high speed stream of CH75 during Day 1 (20 Apr). A further low confidence enhancement is possible on Day 2 (21 Apr) from CH76, although this has been closing up as it moves across the disc. If this enhancement does not occur, near background wind speeds are expected from Day 2 onwards.
Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a Slight Chance of Active or G1/Minor Storm intervals if we see a HSS arrival during Day 2.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels, although there is a very gradually increasing risk as the most complex regions rotate westward.
The high energy electron flux has been oscillating between Moderate and High levels in recent

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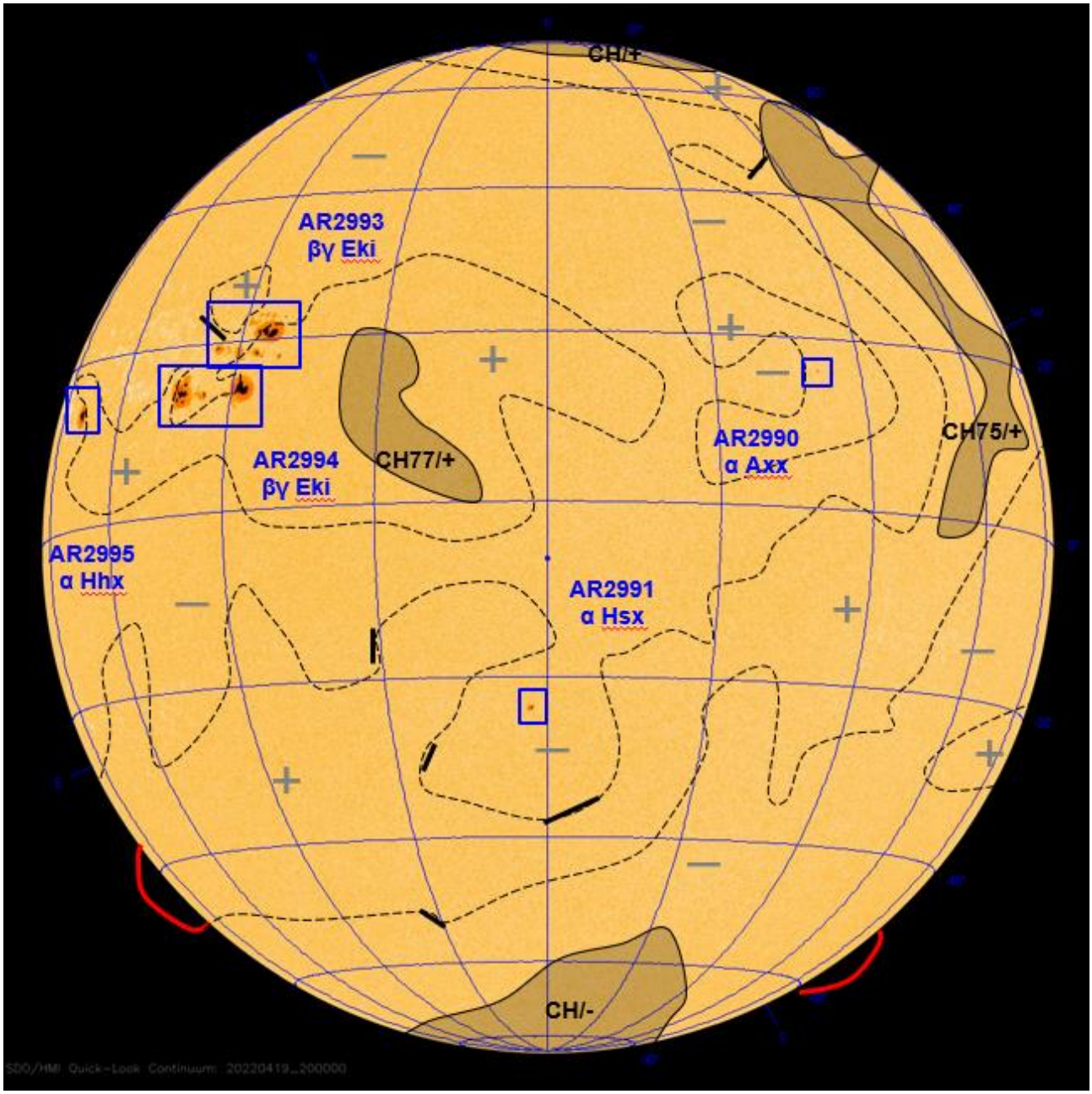
days and is expected to remain similar, in the absence of further significant activity either from HSS or CMEs. The associated fluence is on a rising trend near the Active (1e8 integrated pfu) threshold, and may reach just above Active at times on Day 1 (20 Apr) and in the coming days.

Figure 1. Solar Analysis Valid 19/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no CMEs expected in this forecast period, although there is a small chance of minor unforecast transient features due to the sheer number of CMEs observed over recent days.

Earth is likely to continue exiting from the high speed stream (HSS) of coronal hole 75 during Day 1 (20 Apr). There was also a small feature numbered coronal hole 76, which could potentially give an enhancement on Day 2 (21 Apr). However, this has been closing up as it transited the western hemisphere and may no longer be likely to give any enhancement at all. Looking at STEREO-A data (2.5 days upwind in the Parker spiral), this has seen a CIR-like enhancement in the last 36 hours but the data is very noisy and there is the possibility it could have been a CME arrival at STEREO. Overall, from near background wind speeds early on Day 2 an increase to above 500 km/s is possible through into Day 3, starting to decline into Day 4 (23 Apr), but with low confidence. In the absence of any enhancement from CH76, near background wind speeds are expected from Day 2 onwards. This being a positive coronal hole, significant geomagnetic response is not expected if a HSS does occur.

Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a Slight Chance of Active or G1/Minor Storm intervals if we see a HSS arrival during Day 2.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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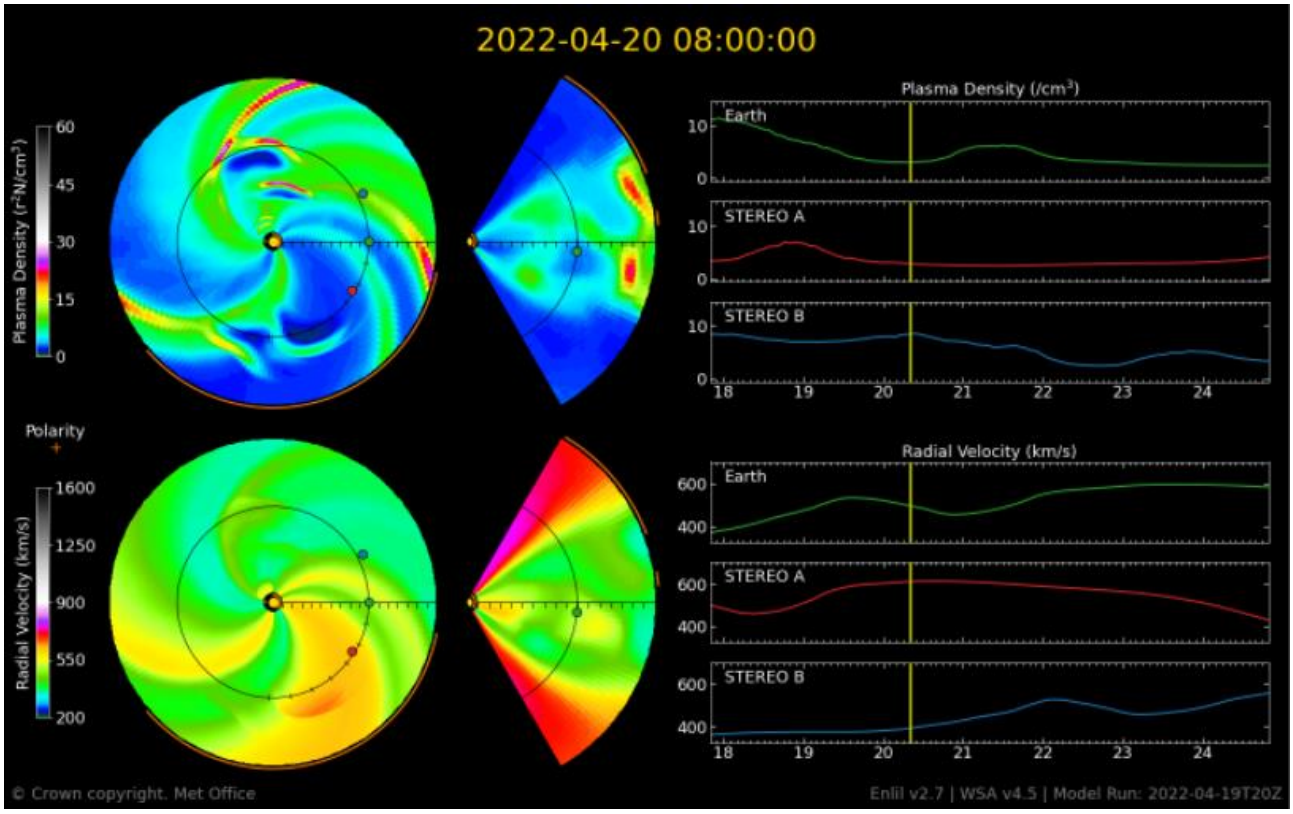
Figure 2: Enlil model showing a rise in wind speed on Day 2, but this is currently low confidence.



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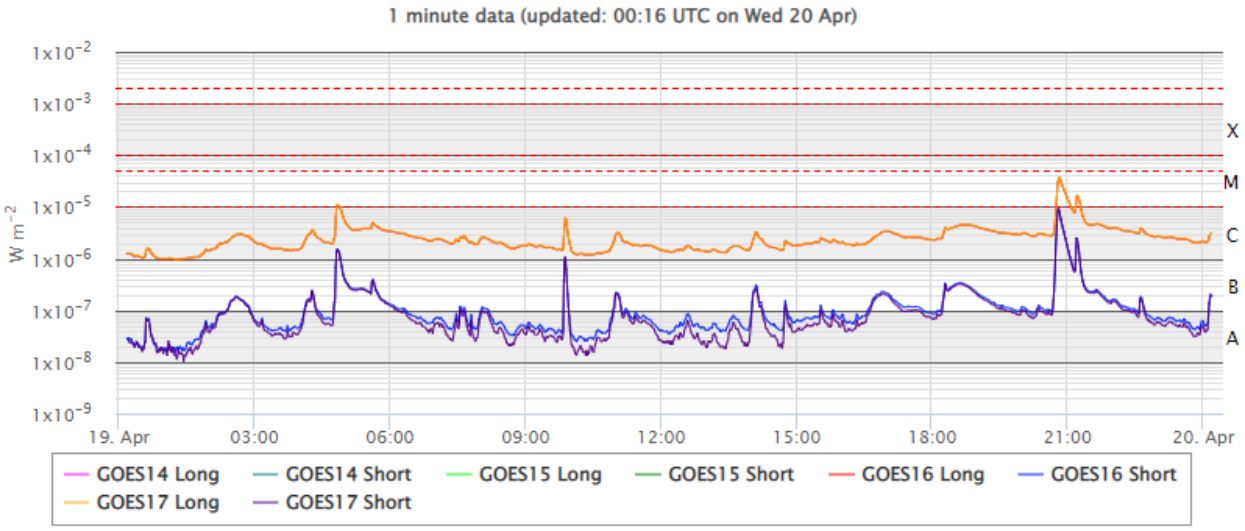
Radio Blackouts - X-Ray Flares:
The sunspot regions in the northeastern quadrant are likely to give the main flare risk through this period, with this area announcing its intent with an X1.1 on 17 April from AR2994, before the focus of activity shifted northwards to its immediate neighbour AR2993, with occasional M-class activity here. We have also seen M-class flaring from ex-2992 over the southwest limb. This provided the largest flare of the last 24 hours, but should be a declining risk as it rotates further away.

AR2993 and AR2994 in the northeast are both classified Eki/Beta-Gamma, and are the largest and most complex areas on the visible disc. AR2995 (Hhx/Alpha) near the northeast limb is currently stable, and whilst there was some doubt whether this was the leading spot of a larger group, it is now starting to appear as though this is not the case. AR2990 and AR2991 are both small and simple. There are signs of another region rotating onto the northeast limb, but this can't be assessed yet and flare probabilities will be held steady until this region can be seen better.
M-class flares are considered Likely throughout, with a Slight Chance of X-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: X-ray trace showing an M1 flare at 19/0453 UTC from AR2993 and an M3 flare at 19/2050 UTC from ex-2992 over the southwest limb.



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.

The recent most active spot, ex-2992 now over the southwest limb, has given a further M-class flare in recent hours however there has been no evidence of any accompanying solar radiation storm. There remains a slight risk from this region at first until it rotates further away from the visible disc. Then the main risk then transfers to AR2993 and AR2994 as they rotate further west, as one of these regions proved capable of reaching S1 on the previous rotation. Overall, there is a slightly rising risk of S1 through the coming days, albeit remaining low throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	7	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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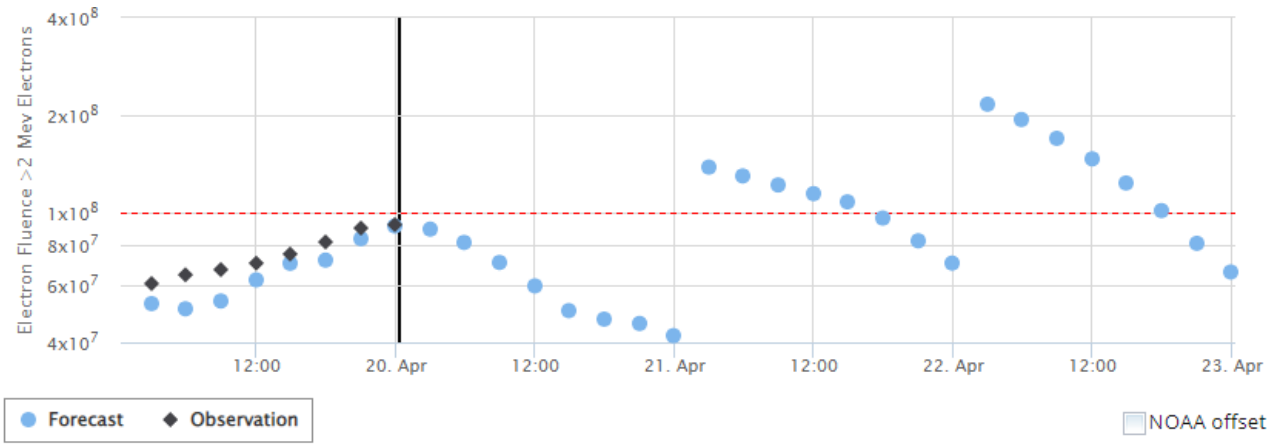
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux as observed by GOES-16 at GEO has been oscillating between Moderate and High levels in recent days and is expected to remain similar, in the absence of further significant activity either from HSS or CMEs. The rising flux levels are in response to the recent HSS from CH75. A further HSS from CH76 is possible on Day 2 (21 Apr) but this is low confidence. If it does occur it may cause a temporary suppression in flux levels, but it now seems possible that this will not occur and flux levels will remain similar to their current level.

The associated fluence is on a rising trend and is now near the Active (1e8 integrated pfu) threshold, and may peak just above Active at times on Day 1 (20 Apr) and in the coming days. MOSWOC REFM has been variable, first suggesting a rising trend then a declining trend, and should not be followed too closely.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	80	70	60	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: REFM model showing variation in its trend, and therefore should be used with caution.



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